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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/784,186	02/24/2004	Ping-Wei Lin	040108	1106

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EXAMINER

NGUYEN, THANH T

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 09/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/784,186

Applicant(s)

LIN ET AL.

Examiner

Thanh T. Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 July 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Request for Continued Examination

The request filed on 7/20/06 for a Request for Continued Examination (RCE) under 37 CFR 1.114 is acceptable and an RCE has been established. An action on the RCE follows.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 5-7 are stand rejected under 35 U.S.C. 102(b) as being anticipated by Lee et al. (U.S. Patent No. 6,033,981), as previously applied.

Referring to figures 3-5, 13, Lee et al. teaches a method for gap filling between metal-metal lines, comprising:

providing a semiconductor structure, a surface of said semiconductor structure has a plurality of metal lines (12, see figure 3) thereon;

forming a first dielectric layer (14) on a surface and a side wall of said plurality of metal lines by a first high density plasma (see figure 4, col. 3, lines 3-8);

removing said first dielectric layer until a portion of said side wall of said plurality of metal lines are exposed by a second high density plasma , wherein a portion of said first dielectric layer with a geometric shape is on some of said metal lines (see figure 5, col. 3, lines 8-16, lines 27-30, noted that dry isotropic etch in CF_4/CHF_3 is plasma etch, because gases have to plasmanizing in order to etch); and

forming a second dielectric layer (22) on said first dielectric layer by a third high density plasma to fill gaps between the metal lines and cover said plurality of metal lines and the portion of the first dielectric layer with the geometric shape thereon to form an inter-metal dielectric layer (see figure 13, col. 3, lines 39-45, 58-67).

Regarding to claim 5. wherein the material of said plurality of metal lines is selected from the group consisting of AlCu alloy and Al alloy (see claim 2).

Regarding to claim 6. wherein the material of said first dielectric layer is silicon dioxide (14, see col. 3, lines 3-8).

Regarding to claim 7. wherein the material of said second dielectric layer is silicon dioxide (22, see figure 13, col. 3, lines 39-44).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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Claims 2-4, 8-27 are stand rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (U.S. Patent No. 6,033,981) as applied to claim 1, 5-7 in view of Kim et al. (U.S. Patent Application Publication No. 2004/0119170) and Lee et al. (U.S. Patent No. 6,103,630), as previously applied.

Referring to figures 3-5, 13, Lee et al. teaches a method for gap filling between metal-metal lines, comprising:

providing a semiconductor structure, a surface of said semiconductor structure has a plurality of metal lines (12, see figure 3) thereon;

forming a first dielectric layer (14) on a surface and a side wall of said plurality of metal lines by a first high density plasma (see figure 4, col. 3, lines 3-8);

removing said first dielectric layer until a portion of said side wall of said plurality of metal lines are exposed by a second high density plasma , wherein a portion of said first dielectric layer with a geometric shape is on some of said metal lines (see figure 5, col. 5, lines 8-16, noted that dry isotropic etch in CF_4/CHF_3 is plasma etch, because gases have to plasmanizing in order to etch; and

forming a second dielectric layer (22) on said first dielectric layer by a third high density plasma to fill gaps between the metal lines and cover said plurality of metal lines and the portion of the first dielectric layer with the geometric shape thereon to form an inter-metal dielectric layer (see figure 13, col. 3, lines 39-45, 58-67).

However, the reference does not teach forming a semiconductor device by flowing first, second, and third mixed gas mixed gas in the chamber with both low frequency radio frequency power and high frequency radio power with a bias voltage on an electrostatic chuck, removing

the first dielectric layer by using high density plasma, the metal lines comprising an adhesive layer, and an antireflection layer of SiON.

Kim et al. teaches a method of forming a semiconductor device, forming a dielectric layer silicon oxide by using SiH₄ (depositing gas), O₂ (oxidative gas), and Ar (inert gas) in the chamber with both low frequency radio frequency power and high frequency radio power with a bias voltage on an electrostatic chuck, removing the first dielectric layer by using high density plasma (see paragraphs# 46-49).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would flowing first, second, and third mixed gas mixed gas in the chamber with both low frequency radio frequency power and high frequency radio power with a bias voltage on an electrostatic chuck, removing the first dielectric layer by using high density plasma in process of Lee et al. as taught by Kim et al. because the process is known in the art to eliminate the formation of void on the surface of the dielectric layer.

Lee et al. teaches a method forming an adhesive layer (32) on the under side of the metal lines (24), forming an antireflection layer SiO_xN_y (ARC, 26/28) on the metal line layer.

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would forming a metal lines with an adhesive layer on the under side of the metal and antireflection layer on top of the metal line layer in process of Lee et al. as taught by Lee et al. because antireflection layer would prevent the reflection of light and the adhesive layer would provide the adhesion between the metal line and the underlying layer.

Response to Arguments

Applicant's arguments filed 7/20/06 have been fully considered but they are not persuasive.

Applicant contends that Lee et al. does not teach a step of forming a second dielectric layer on the first dielectric layer by a third high density plasma to fill gaps between the metal lines and cover said plurality of metal lines and the portion of the first dielectric layer with the geometric shape thereon to form an inter-metal dielectric layer. In response to applicant, Lee et al. clearly teach forming a second dielectric layer (22) on said first dielectric layer by a third high density plasma to fill gaps between the metal lines and cover said plurality of metal lines and the portion of the first dielectric layer with the geometric shape thereon to form an inter-metal dielectric layer (see figure 3-5, 13, col. 3, lines 39-45, 58-67).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:00AM to 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, can be reached on (571) 272-1702. The fax phone number for this Group is (571) 273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pairdirect.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Thanh', with a long horizontal stroke extending to the left.

Thanh Nguyen
Patent Examiner
Patent Examining Group 2800

TTN